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Ground pressure behavior law at fully-mechanized face in Fenxi-ShuGuang coal mine

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Abstract

In this paper, based on field observations and theoretical analysis, we discussed the ground pressure behavior law and its characteristic at fully-mechanized face and the material roadway of 10# seam in Fenxi-Shuguang coal mine. The analysis results indicates that ground pressure at material roadway increased sharply when the working face advanced to place 40~50m away from it, and as the advance of the working face, the deformation of the two-sides is clearly bigger than that at the roof and floor in material roadway; Therefore, support in material roadway should be strengthened to ensure the safe mining of working face. We use the ZDYJ-IIA type computer-round figure apparatus to observe the ground pressure of the fully-mechanized face, which can help us analyze the relation of the fully-mechanized mining technique with ground pressure as the advance of the working face, as well as obtain the ground pressure behavior law of fully-mechanized face and calculate pace length of the periodical roof pressure. Analysis on the real-time monitoring results of the setting load and the work resistance show that the hydraulic powered supports used at the working face can fulfill the needs of the working face pressure. Finally, we can obtain the conclusion that the method of the ground pressure observation is scientific and feasible, which includes the real-time monitoring on the fully-mechanized face and placing the observation stations in the material roadway to observe the deformation of material roadway.

Keywords: ground pressure behavior; computer-round figure apparatus; real-time monitoring

1. Introduction

The 9#, 10# and 11# coal seams are principal ones mined in Fenxi-shuguang coal mine. In order to investigate the phenomenon law and character of ground pressure for fully-mechanized face and the material roadway of 10# seam in Fenxi-shuguang coal mine, we carried out the ground pressure observation at the 31001 working face. The component of 10# coal seam mined at the 31001 working face are most clarain and half-clarain, with dull coal taking the second place; and the 10# coal seam is samdwich and belongs to the mid-intensity seam. This coal seam is stable, the average thickness is 3.6m with a dip angle of 2-6°; the bulk specific gravity is 1.45t/m^3, and the press coefficient is 0.8, the average uniaxial compression strength is 7.7MPa, with a variation ration of 18.8%. The northeast side of the 31001 fully-mechanized working face is the transport laneway, the southwest side is the

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material laneway, the northwest side is the incision laneway. The working face advances from northwest to southeast, and there is 20m obstructive ridge at the boundary of mine with the incision laneway. The roof-to-floor parameters of the 31001 fully-mechanized working face is particularly showed in the Table.1.

This working face adopts the MG300/700-DW type coal-winning machine to mine with the longwall comprehensive mechanized coal mining method, , and transports coal by using the SGZ-764/630 type rake conveyor. This working face chooses ZZ4000-19/40 type hydraulic support, and use the caving method for roof control.

The 31001 working face principally mines the 10# seam with a full-seam mining method, the. Which means the average mining height is 3.6m The working face uses 95 units ZZ4000-19/40 type hydraulic supports and 3 units ZZ4000-17/35 type hydraulic supports to control deformation of roof[1-3].

Table 1. Condition of roof and floor

Name	Rock name	Thickness (m)	Rock character
Roof	Lime rock	6.0	Dark grey, dense hard, non-caving
Immediate roof	Shale rock	1.5	Dark grey, lamination and joint equalizing development f=5
False roof			
Immediate bottom	Shale rock	0.4	Grey, lamination development f=5
floor	Sandrock	1.3	Grey, contain calcite vein f=5

Table 2. Strata pressure data of material laneway

Distance (m)	Position	Displacement (mm)			Speed (mm/d)			Statistic /unit	Remarks
		Max	Min	Average	Max	Min	Average		
≤50	Roof	32	9	16.53	4.83	1.33	2.46	15	Region with obvious displacement
	Two-sides	45	11	32.93	9.17	3.33	5.02	15	
50~100	Roof	31	7	16.14	2.07	0.47	1.12	15	Region with small displacement
	Two-sides	49	7	29.35	3.27	0.58	1.94	15	
Total displacement	Roof	46	20	33	2.56	0.95	1.64	15	
	Two-sides	80	39	62	4.33	2.17	3.04	15	

2. Measurement methods

In order to study the phenomenon law of ground pressure of the 10# in Fenxi-shuguang coal mine, evaluate the management mode of roof-to-floor in the working face at present, analyze the rationality of the supports capacity and predict possible roof accidents, we carried out the following observation plans:

(1) The ZDYJ-IIA type computer-round figure apparatus is used to continuously observe the ground pressure of the 310031 fully-mechanized face, a with 6 to 10 measuring points along the length direction of the working face, and we carried out analysis based on the press data recorded continuously

The measuring range of the ZDYJ-IIA type computer-round figure apparatus is 0~60MPa, and the accuracy is 2%. The ZDYJ-IIA type computer-round figure apparatus include 4 parts: □pressure monitor recording extension set; □infrared transmit data collector; □infrared data computer message adapter; □data processing software. The pressure monitor recording extension set has 1~4 pressure measurement holes, which can measure the press of two holes at the same time and continuously records them into extension sets. 1~20 sets and 1 data collector can be disposed at one working face, but just need one data collector, who is taken out of the mine automatically transmit the data to PC through the infrared data computer message adapter.

(2) 10~15 observation stations are disposed along the material laneway of the 310031 fully-mechanized face, and we disposes couple roof and floor displacement measuring points and a couple two-sides displacement measuring

points in each station. The space length of two stations is generally5m, but sometimes they are disposed based on the practical situation of laneway.

3. Observation data analysis

3.1. Material laneway observation data analysis

Through the observation results of the roof-to-floor displacement (Table.2), we can find that the material roadway is influenced from the time when the distance between it and the working face is less than 80~90, and the influence becomes larger and larger until the distance decreases to 40~50m when the displacement increases greatly and then comes into press presentation region. As advance of the working face, the deformation variation of the two-sides is clearly bigger that of the roof-floor, and the former is faster. At the beginning the deformation of the roof-floor is bigger, but as the working face advanced, the deformation of the two-sides is bigger. The results show that support of the two-sides should be increased as advance of the face.

The daily advance of the working face towards to 1# observation station was 2.74m, while the figure for 15# observation station was 4.1m. W can see from the displacement curve of 1# and 15# observation stations that(Fig.1), the total displacements and the deformation velocity for measurement station with larger daily advance distance is bigger than that with smaller daily advance distance.

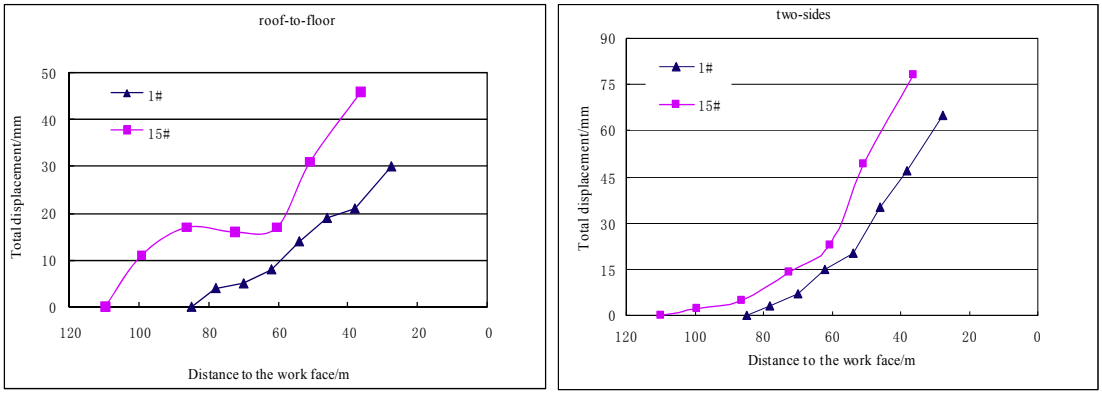

Fig. 1. Displacement curve of 1# and 15# observation stations

Table 3. Extension number correspondence support number and fixed position

Extension number	3	4	6	9	5	16	10	11	12	2	14	15
Support number	8	16	24	32	40	48	56	62	72	80	88	96
Position	upper	upper	upper	upper	mid	mid	mid	mid	below	below	below	below

3.2. 31001 working face observation data analysis

The 31001 working face principally mined the 10# seam, and the thickness of this coal seam is 3.6m, which is also the average mining height The working face uses 95 ZZ4000-19/40 type hydraulic supports and 3 ZZ4000-17/35 type hydraulic supports to control roof. The ZDYJ-IIA type computer-round figure apparatus is used to continuously observe the ground pressure of the 310031 fully-mechanized face, and 12 measuring points are disposed along the length direction of the working face. The extension number correspondence support number and fixed position was showing in the Table.3.

Because the ZDYJ-IIA type computer-round figure apparatus was not fixed in time, we failed to observe the movement phenomenon law of the first roof pressure. It appeared three coming press during the observation period, and the pace value of the periodical roof pressure was 8.6m and 8m respectively, and the pace value of the

periodical roof pressure was approximately the same through the analysis of the others data. with a value of 8~9m, and the period of the periodical roof pressure being 2~3 days.

Measurement on the average pressure of the every support shows that all of them did not exceed35Mpa. The ground pressure of the working face behaved dynamic variation from time to time along the working face advanced and the change of the geological conditions. And the law of the periodical roof pressure can be basically reflected through the change of average pressure curve.

Fig.2 shows the daily average press curve of the every support. We can see from Fig.2 that the average press data of most of supports are approximate except 95# support whose average press of is smaller. The overall trend of the average pressure is that the pressure of the upper part is bigger than that of the lower part with a regular wave-motion change.

Fig.3 is the Max. Setting load change chart for the 8th and 56th supports. We can see that both daily Max. setting loads are less than 25MPa, which is less than the load. Moreover, i supports. we can see from fig.4 that the Max. working resistance of both the 8th and 56th supports are less than 30MPa, which is also less than the limit load . Overall, analysis results of the setting load and the work resistance indicate that the hydraulic supports used at the working face can fulfill the needs of working face pressure, which secure the safe mining of 31001 working face.

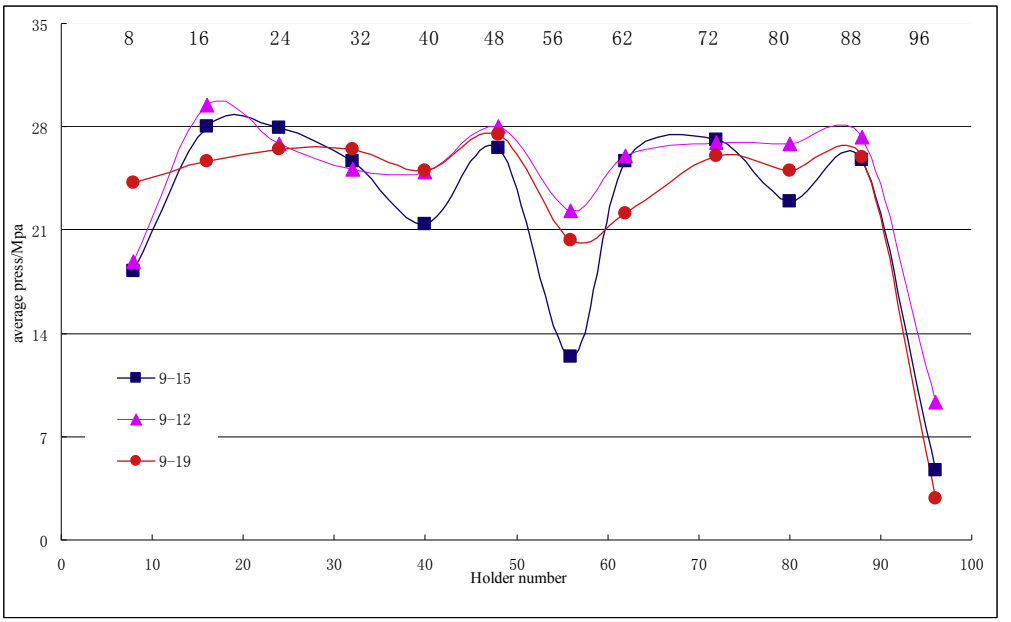

Fig. 2. Average press of supports at Sep 12, 15,19

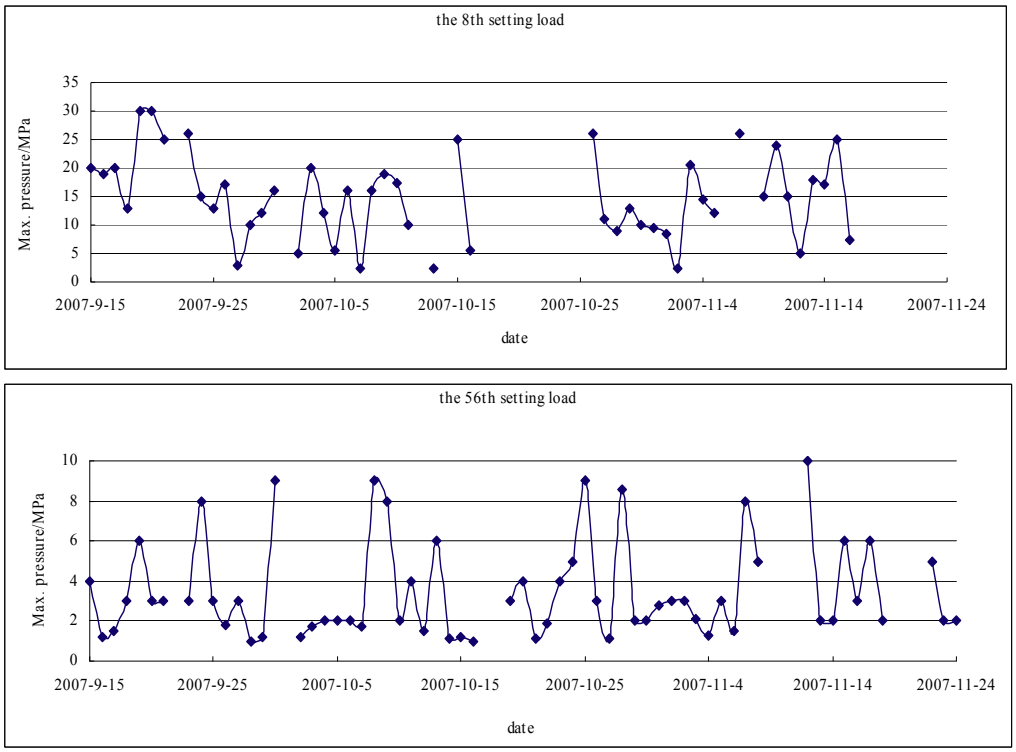

Fig. 3. Max. setting load of the 8th and 56th supports

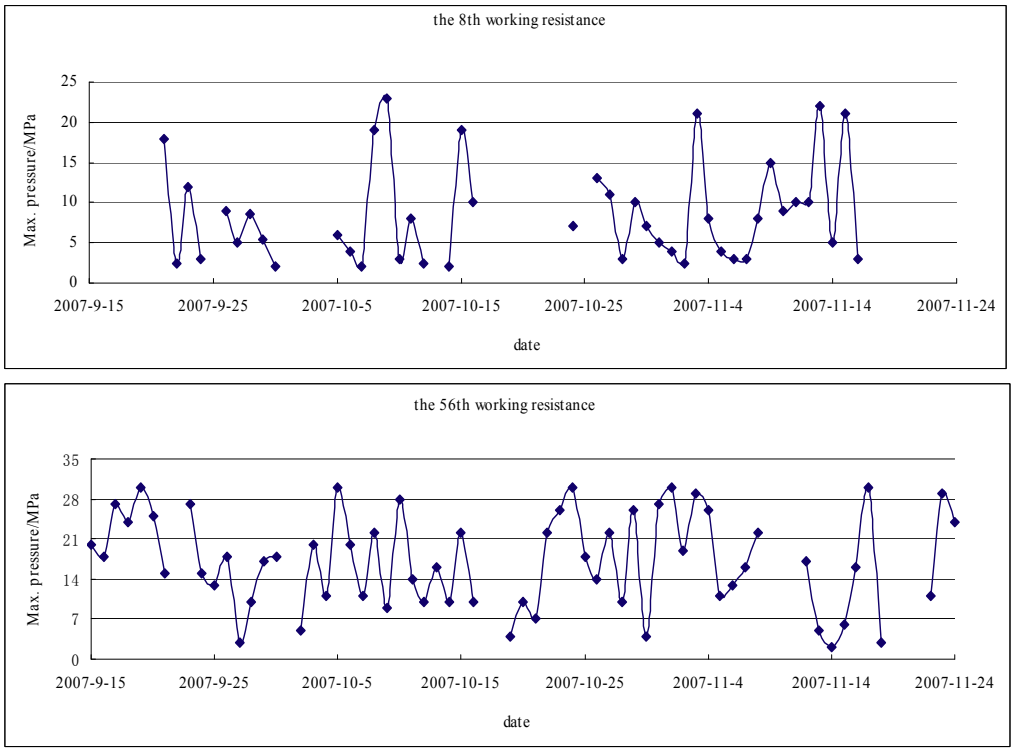

Fig. 4. Max. working resistance of the 8th and 56th supports

4. Conclusion

In this paper, based on field observations and theoretical analysis, we discussed the ground pressure behavior law and its characteristic at fully-mechanized face and the material roadway of 10# seam in Fenxi-Shuguang coal mine. The analysis results indicates that ground pressure at material roadway increased sharply when the working face advanced to place 40~50m away from it, and as the advance of the working face, the deformation of the two-sides is clearly bigger than that at the roof and floor in material roadway; Therefore, support in material roadway should be strengthened to ensure the safe mining of working face. We use the ZDYJ-IIA type computer-round figure apparatus to observe the ground pressure of the fully-mechanized face, which can help us analyze the relation of the fully-mechanized mining technique with ground pressure as the advance of the working face, as well as obtain the ground pressure behavior law of fully-mechanized face and calculate pace length of the periodical roof pressure. Analysis on the real-time monitoring results of the setting load and the work resistance show that the hydraulic powered supports used at the working face can fulfill the needs of the working face pressure. Finally, we can obtain the conclusion that the method of the ground pressure observation is scientific and feasible, which includes the real-time monitoring on the fully-mechanized face and placing the observation stations in the material roadway to observe the deformation of material roadway.

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